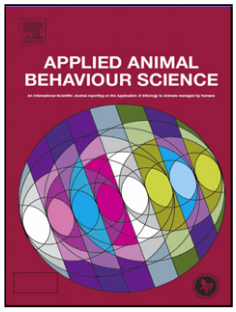
The importance of learning theory and equitation science to the veterinarian



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TITLE PAGE

The importance of learning theory and equitation science to the veterinarian

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REVIEW ARTICLE

Abstract

The work of veterinarians when handling horses exposes them to high risk of injury. Among equine practitioners, the incidences of work-related injuries and work days lost due to injury are high. Equine veterinary practitioners' knowledge of learning theory and equitation science is minimal. Increasingly veterinarians are expected to provide a leadership role in animal welfare, including behaviour medicine. However, due to deficiencies in veterinary training, which traditionally focuses on physical aspects of health, veterinarians may be under equipped to deal effectively with all aspects of animal behaviour. Advancing veterinarians' understanding of the application of learning principles for horses would improve safety, increase ease of handling and restraint during clinical procedures and increase clinical efficacy. As the risk of injury declines, so too would the risk of litigation. Through example, veterinarians are ideally placed to influence and educate equestrian personnel in best practice handling and restraint methods. Training methods that do not align with the horse's natural learning abilities reduce the likelihood of optimal performance and increase the frequency of problem behaviours as well as jeopardising equine welfare. Detection of inappropriate training practices is an essential part of the veterinarian's role in identifying and addressing causes of sub-optimal performance in the equine athlete. Poor performance and problem behaviours that result from the use of inappropriate training practices may contribute significantly to the current levels of wastage in the horse industry. Education of veterinarians in equitation science could play a pivotal role in reducing wastage and improving horse welfare globally.

Keywords:

Equitation science

Learning theory

Veterinarians

Safety

Welfare

Performance

1. Introduction

Working with animals presents various dangers, so animal handling is a critical skill for veterinary students and veterinarians. Large animal practitioners are most likely to have chronic or significant injuries (Fritschi et al., 2006). For equine veterinarians, the principles and practise of effective and humane horse-handling are of critical importance. An Australian study of veterinarians (n=2800), reported that 51% had sustained a significant work-related injury during their career and 26% had been injured within the past 12 months (Fritschi et al., 2006). For a similar study in the US, the figures were 65% and 17%, respectively (Landercasper et al., 1988). A survey of 621 equine veterinarians in the UK found that 5-8 work related injuries, sufficiently serious to affect ability to work, could be expected over a 30 year working life (BEVA, 2014).

The physical demands and risks of injury associated with equine veterinary work are known to lessen the enjoyment of this career choice (Heath, 2004). Clearly, veterinarians not

only have to take responsibility for their own safety but also the safety of their personnel and patients and as well as clients and their agents (McGreevy and Dixon, 2005). This is a significant legal responsibility, especially when the patient requires sedation, anaesthesia, euthanasia, suturing or may be in behavioural extremis (e.g. upside down in a horse trailer after a road-traffic accident). Little of what veterinarians do as part of their equine practice aligns with the equid ethogram (McGreevy et al., 2009). It should not be assumed that horses know interventions are for their long-term benefit and undoubtedly many aspects of veterinary attention are aversive

The value of horsemanship in veterinary contexts has been described recently (Payne et al., 2015). Horses that are handled correctly are easier to both examine and treat, while those that are poorly handled struggle more and become generally distressed (McGreevy, 2004).

Ideally, equine veterinarians should be able to explain to their clients and personnel the need for evidence based methods of horse handling (Payne et al., 2015). To do so, they must demonstrate best practice in horse handling and establish credibility in this domain with horse owners (McGreevy et al., 2011). They must recognise the occupational health and safety responsibilities of veterinarians when handling horses (Fritschi et al., 2006). While veterinarians will benefit from the increases in efficiency of interactions between horses and humans when learning theory is applied, this approach also reduces exposure to litigation as a consequence of improved calmness during veterinary interventions – and fewer potentially dangerous evasive responses by the horse (McLean and McGreevy, 2010).

The principles that underpin good horsemanship in veterinary contexts are built on knowledge of equine behaviour, especially learning. Equine veterinarians must be able to anticipate the aversive aspects of human-horse interactions and most veterinary interventions for horses (McGreevy et al., 2009). They must recognise typical equine flight responses and

their consequences, and how to prevent these responses. They should be able to explain and utilise the principles of stimulus control, pressure-release, timing, consistency, and over-shadowing (McGreevy and McLean, 2010).

Experienced equine professionals can assess horse reactivity and responses to in-hand stimuli and recognise threatening and dangerous responses in horses. They recognise how different horses (e.g. stallions) may differ in their behavioural tendencies and how context can influence these tendencies. They also recognise worst-case scenarios. Regardless of whether or not they are students of equitation science, they apply the principles of associative and non-associative learning to the implementation of in-hand signal/response associations (McLean, A. 2005b). This allows them to achieve stimulus control of the horse's locomotory responses so that the horse becomes manageable and subsequently relaxed.

Veterinarians who cannot handle horses effectively, are mostly unable to teach their clients how to do so, an unfortunate spiral that can compromise the animal's health and welfare and ultimately cause suffering (McGreevy and Dixon, 2005). In contrast, outstanding horse-handling skills not only advance safety but also impress clients. The best equine veterinarians not only demonstrate best practice in restraint for veterinary interventions but also disseminate best practice (McGreevy, 2004). For example, they can improve the horse's groundwork so that clear effects are seen and the handler and/or owner can continue to apply this approach in order to ensure the horse's overall well-being, effective training and safety. Furthermore, they recognise and, where appropriate, suggest modifications to dangerous horse-handling facilities and handling methods (McGreevy, 2004). Veterinarians can assess a client's or colleague's ability to apply the fundamental principles of learning and keep records on behavioural reactivity and responses to in-hand

signals of equine patients and document instances in which handling issues compromise their ability to perform adequate examination or treatment.

This review explains the importance of veterinarians having an understanding of learning theory to optimize effectiveness of handling and restraint within the veterinary context, and notes that the use of coercion and punishment is no longer considered ethical or to be best practice in animal handling (McGreevy and McLean, 2009). It also reviews the prevalence of work-related injuries to equine veterinarians and describes the level of the teaching of learning theory (in the context of equine species and others) and components of equitation science in veterinary curricula worldwide. The article also examines the relationship between equitation science and equine performance, noting the role of suboptimal training methods in preventing horses from reaching their perceived potential in performance (McGreevy et al., 2011) and how operant conditioning is affected by mood and arousal (Starling et al., 2013). The review then considers how equine welfare problems can reflect widespread lack of understanding of the science that underpins horse training and how this translates to unacceptable levels of so-called wastage in various sectors of the equine industry (Thomson et al., 2014).

2. Work-related injuries to equine veterinarians

2.1. *Prevalence*

A high prevalence of work-related accidents and injuries is recognised within the veterinary profession, particularly among those who work with horses (Fritschi et al., 2006; Jäggin et al., 2005; Phillips et al., 2000; Reijula et al., 2003). Veterinarians and associated support staff are 9.2 times more likely to experience a severe occupational accident than their

medical colleagues and 2.9 times more likely to make a medical insurance claim following an accident (Nienhaus et al., 2005). In a study investigating occupational fatalities in America, not restricted to veterinarians, horses were responsible for 27% of 350 fatalities, second only to cattle (Langley and Hunter, 2001). A similar study in New Mexico found horses to be the prime cause of animal-related fatalities, being responsible for 68% of 63 deaths (Lathrop, 2007). This study also included recreational fatalities, which may explain the reduced prevalence of cattle-related deaths. With increasing awareness of equine behaviour, and increasing popularity of methodologies that people consider to be based on ethology (Rozempolska-Rucinska et al, 2013), it is possible that these figures may have changes over the last decade.

A study of Irish veterinary practitioners (n=89) found that 59.5% of veterinarians required medical care, 34% had to take time off work and 13.5% were hospitalised due to work-related musculoskeletal symptom (O'Sullivan and Curran, 2008). These work-related injuries include not only accidents but also chronic musculoskeletal disorders and work-related stress (O'Sullivan and Curran, 2008; Reijula et al., 2003). Similarly Fritschi et al. (2006) found that 51–68% of Australian veterinarians are expected to sustain a significant work-related injury in their career and 26% had at least one injury in the past 12 months. Large-animal practitioners appear to be at greatest risk, with practitioners in large or mixed practice being >10 times more likely to have sustained a recent injury (Landercasper et al., 1988; Langley et al., 1995; Nienhaus et al., 2005; Phillips et al., 2000; Reijula et al., 2003). In America a survey of veterinarians in Minnesota found that 64.6% had sustained a major animal-related injury (Landercasper et al., 1988). Of these 17% were hospitalised and of those 25.3% required surgery. A study looking at Finnish veterinarians found good awareness of the risks of being involved in a work-related accident. The risk of an accident was considered to be fairly or very high by 71% of veterinarians in equine practice in comparison

to 57% of mixed practitioners (Reijula et al., 2003). This is not surprising considering that 34% of women and 35% of men included in the study had suffered a work-related accident in the past 12 months.

In a study analysing accident insurance data in Germany, 87.7% of 2,058 claims made by veterinarians were made after an occupational accident, and were more likely to be from veterinarians working with large animals (Nienhaus et al., 2005). In this study horses were responsible for 26% of all animal-related accidents.

In one of the most recent and comprehensive studies of its kind, the British Equine Veterinary Association (BEVA) highlighted the fact that equine veterinarians in the UK are more likely to sustain an injury than any other civilian occupation, including those working in the construction industry, prison service and fire brigade (BEVA, 2014). During a 30-year working life, they suggest the average equine veterinarian will sustain 7–8 work-related injuries that impede them from practising.

2.2. Severity and Treatment

The severity of injuries sustained while working with horses is also a cause for concern. Lucas found that of 2188 serious injuries sustained by equine veterinarians where 18.8% resulted in hospital admission, 17.4% resulted in attendance at an accident and emergency department, 33.8% required treatment by a general practitioner and 24.5% were self-treated (Lucas et al., 2009). Self-treatment is common among veterinary practitioners, who have what they consider to be adequate medical knowledge and equipment. This is reflected in a survey undertaken in Minnesota and Wisconsin (Landercasper et al., 1988). In this study 17% of veterinarians sustaining an animal-related injury required hospitalisation and 25.3% of these required surgery. However 4% of veterinarians reported reducing their own fractures/

dislocations, 20% sutured their own lacerations and 67.5% self-administered antibiotics. While the prevalence of self-treatment nearly 30 years later is likely to be much reduced, it is still likely to contribute to under-reporting of the true injury rates. These figures represent a significant financial burden to the health services of their respective countries.

2.3. Loss of working time

In the Australian study conducted by Lucas et al. (2009) the mean number of days absent from work following injury was 7.4 days (range 0–180). While 60% of injuries resulted in a day or less absent from work, 11% required eight or more days' absence. The veterinary profession generally is considered to have a mentality of working in spite of injury and individuals may return to work sooner, or continue to work when they should not, due to perceived peer pressure. Working in spite of injury can lower productivity and Lucas et al. (2009) found veterinarians reported a mean of 16.7 days following injury in which their work was restricted (range 0–365), with 40% of veterinarians reporting 8 or more days. Days lost from work and reduced productivity at work represent a burden not only on the individual but also on the practice and profession as a whole (Lucas et al., 2009). As well as time lost during employment, a number of veterinarians choose to leave the equine sector; this may be due in part to ongoing health problems resulting from a previous injury sustained at work (BEVA, 2014) or to a lack of job satisfaction as a result of dealing with difficult horses and sometimes unreasonable clients. Situations such as dealing with an equine that refuses to stand still to be examined and repeatedly kicks out, while the client refuses to restrain him, lead to frustration for the veterinarian. A survey of equine veterinarians in Australia (Heath, 2004) revealed the commonly cited disadvantages of equine work included, among others: clients with unreasonable demands, clients unable to control their horses, clients who provided poor

facilities, the degree of physical strength and exertion required, the risk of injury, especially with ineffective handlers and/or inadequate facilities and especially with fractious horses. These results suggest that with an increasingly female population of equine veterinarians, who may be less likely to accept the physical side of this work, there may in the future be a shortage of equine veterinarians competent in equine handling (Heath, 2004).

2.4. Risk factors

Recent graduates are more likely to sustain an injury than more experienced veterinarians (Fritschi et al., 2006; Gabel and Gerberich, 2002); this may reflect experience gained over time or that younger veterinarians are more willing to take risks to impress colleagues and clients. Specific procedures most commonly associated with injury include wound care, suturing, castration and stomach tubing (Lucas et al., 2009). Working closely with animals and often undertaking procedures that may be aversive or even painful for the animal involved, may increase the risk, as does having to physically restrain a large and powerful animal such as a horse (Fritschi et al., 2006). Even horses that are normally placid may react aversely when subjected to novel or painful stimuli such as may be experienced during veterinary examination and treatment (MacLeay, 2007).

As a risk factor animals are the most frequent cause of occupational accident in the veterinary profession and method of injury is commonly due to a bite, scratch or kick. Unsurprisingly bone fractures are approximately 10 times more likely to occur when working in large-animal practice (Nienhaus et al., 2005). Various factors including reportedly “Wild animal” (83%) and “insufficient help” (74%) were considered severe or moderate risk factors in a Finnish study in which 34% of women and 35% of men had sustained a work-related injury in the past 12 months (Reijula et al., 2003). Describing a horse as a “wild” animal

suggests it has had poor training or limited prior handling. Williams and Ashby (1992) found horse behaviour to be the most significant risk factor for injury to riders and handlers, and that it was often associated with a fear response. In a similar study Ball et al. (2007) described associations between major traumatic injuries to equestrians and hyper-reactive responses (spooking), insufficient training and a bad temperament. This should not be surprising as Keeling et al. (1999) suggested the greatest proportion of equine-related deaths were behavioural (for example bolting or bucking) rather than being performance related (for example miscalculating the height of a jump resulting in a rider +/- horse fall). Houpt and Mills (2006) highlight that needle-shy or non-compliant horses are not only a challenge but a threat to the equine veterinarian and yet there is still limited training of handling techniques based on behaviour modification to undergraduate veterinary students. Another risk factor is time, in a Swiss study equine veterinarians were found to be at an increased risk of being kicked when they were rushing as well as when the patient became frightened (Jäggin et al., 2005).

2.5. Type of injury

Bruising, fractures and lacerations are the most common types of injury sustained by equine veterinarians (Lucas et al., 2009; BEVA, 2014). Nearly one quarter of what veterinarians described as their worst-ever injury required hospital admission, and 7% of these injuries resulted in loss of consciousness (BEVA, 2014). The most common sites of injury were the leg (29–33%), head and neck (20–26%) and upper extremities (20–80%) (Landercasper, 1988; Lucas et al., 2009; BEVA, 2014). With regard to fractures, specifically, Lucas et al. (2009) found that they occur most commonly to the face and thorax/ribs followed by the hand, lower leg and foot.

2.6. Cause of injury

The main cause of injury in the study reported by BEVA (2014) was a kick from a hind limb (49%), a strike with a forelimb (11%) and crush injury (5%). A study looking at injuries to Australian equine veterinarians found 79% of injuries involved being kicked or struck by the horse and 12.3% resulted from being crushed, pushed against or stepped on (Lucas et al., 2009). In Minnesota the most common mechanism of injury was a kick (35.5%), bite (34%) and crush (11.7%) (Landercasper, 1988). As this study was not exclusive to equine veterinarians, the higher prevalence of bite injuries is likely to be a result of small-animal work.

When looking at the most severe injuries sustained, the majority occurred when working with pleasure horses (i.e. those owned for recreational purposes) and when the client or owner was the person holding the horse (BEVA, 2014). This may represent a gap in the knowledge of pleasure-horse owners. Horses not under stimulus control, particularly those with poor acceleration and deceleration responses are more likely to exhibit hyper-reactive and conflict behaviours (rearing, kicking, striking, barging). Therefore encouraging pleasure-horse owners to train these basic operant responses may help to reduce this risk (McLean, 2005a).

2.7. Prevention

Reduction in injuries sustained by veterinary surgeons may be achieved by focusing on prevention of accidents caused by animals (Nienhaus et al., 2005). This may be achieved by additional personal protective equipment, to reduce the severity of possible injuries sustained in an accident, and also through steps being taken to prevent these accidents occurring in the

first place. Riding helmets are now accepted as standard equipment for horse riders in most of the modern world, and their use has reduced the prevalence of head trauma (Ball et al., 2007; Hawson et al., 2010; Kriss and Kriss, 1997; Moss et al., 2002). While it is easy to see how a riding hat may offer a protective advantage when falling from a horse, many veterinary hospitals, charity organisations and riding establishments now require staff to wear a riding hat at all times when handling horses (BHS, 2015). Protective vests have also been suggested as useful when equine veterinarians are dealing with fractious horses (Ball et al., 2007; Lucas et al., 2009) although no formal recommendations have yet been made by veterinary associations on this matter. However whilst additional personal protective equipment may reduce the severity of injuries sustained during an accident the ideal scenario would be to prevent accidents occurring in the first place. It is possible that a better understanding of equine ethology, learning theory and arousal levels would allow equine veterinarians to more accurately predict which horses are liable to react aversely, and give them the skills to handle the horse in a way that reduces the risk of an adverse reaction.

3. Teaching of learning theory and equitation science in veterinary curricula

3.1. Knowledge of learning theory among equine professionals

It is commonly advised (Hausberger et al., 2008) that a deeper understanding of equine behaviour may reduce the high prevalence of accidents experienced by equine veterinarians due to the actions or reactions of their patients. However no studies to date have investigated the level of knowledge that equine veterinarians have of the principles of learning or its practical application. Warren-Smith and McGreevy (2008) demonstrated that accredited equestrian coaches in Australia had a poor knowledge of learning theory. In this study 79.5% of coaches considered positive reinforcement to be “very useful” and yet only 2.8% were able

to correctly explain its use in horse training. Just under 51% of respondents explained it as negative reinforcement. With regard to negative reinforcement 19.3% of coaches considered it "very useful" and yet only 11.9% were able to correctly explain its use, with 51.5% explaining it incorrectly as punishment. An adapted version of this study was carried out among accredited coaches in Canada with similar results (Wentworth-Stanley, 2008). In this study 8.6% of Canadian coaches were able to correctly explain negative reinforcement with 54.7% describing it as punishment. Positive reinforcement was correctly explained by only 5.7% of accredited coaches, with 17% describing it as negative reinforcement. Together these studies demonstrate a poor understanding of learning theory among professionals within the equine industry in Australia and Canada. Given that there is little or no teaching of equine ethology or learning theory in the veterinary curriculum, there is no reason to suspect that understanding of learning theory among veterinarians should be any different.

3.2. Literature on learning theory in equine journals

While papers reviewing equine learning have been published in the literature (Christensen et al., 2006; Cooper, 1998; Houpt and Mills, 2006; Mills, 1998a, 1998b; Murphy and Arkins, 2007, Nicol, 2002), very little emphasis has been placed so far on the practical application of this knowledge to the everyday working lives of equine veterinarians. This represents an area that has the potential to reduce accidents and the stress involved in horse–veterinarian interactions not just for the veterinarian, but also for the horse owner and the horse itself.

3.3. Influence of veterinarians on horses behaviour

As understanding equine behaviour has become increasingly popular in recent years,

horse owners now have higher expectations of equine veterinarians to handle their horses according to best practice (McGreevy et al., 2011). While this puts pressure on all equine veterinarians, it is perhaps of most concern to recent graduates. Undergraduate veterinary students are aware that, as most clients are unable to judge their clinical skills, they often judge the competency of the new graduate on his/her ability to handle their horses. This depends not just on their technical competence but also their ability to empathise with the patient (Austin et al., 2007; Cawdell-Smith et al., 2007; Chapman et al., 2007; McGreevy, 2007). Veterinarians are influencing and modifying the behaviour patterns of horses whenever they work with them, whether they intend to or not. It is important to understand that the impact of the actions of the veterinarian depends on how the horse perceives them, not the motives of the handler (Mills, 1998a) and this is why it is important that equine veterinarians have an understanding of the learning processes of horses. It is also fundamental that veterinarians understand that a quick-fix restraint technique may prompt adverse reactions from the horse during subsequent veterinary visits (McLean, 2007).

3.4. Undergraduate Veterinary Training

In line with best practice international veterinary standards, undergraduate veterinary students across many parts of the world, including Europe, North America and Australasia are required to undertake several weeks participating in extramural studies in the earlier years of the veterinary degree. This usually includes a period working in an equine establishment, such as a riding school, professional competition yard or a stud, and this time is designed to aid the development of the student's equine handling skills. Obviously the quality of their learning depends very heavily on the knowledge and ideals of the people supervising them during such placements.

Veterinary colleges also dedicate lectures, practical classes and learning material to the subject of animal handling and in more recent years there has been an increasing emphasis on animal welfare. However, typically the focus of animal handling tends to be on restraint and less on animal behaviour and the application of learning theory. During equine lectures restraint methods, including application of an anti-rearing bit, nose twitch, neck twitch, and holding a foreleg up are frequently mentioned, but systematic desensitisation using negative reinforcement is not discussed (Austin et al., 2007; Cawdell-Smith et al., 2007; Chapman et al., 2007; Hanlon et al., 2007; Stafford and Erceg, 2007). MacLeay (2007) describes how Colorado State University College emphasise the importance of training veterinary students in how the environment and human intervention are liable to affect the animal, as well as knowing how to deal with any responses to keep students safe, encourage job satisfaction and encourage students into large animal practice. Research has shown that a lack of experience, coupled with frequent use of physical restraint deters students from entering large-animal practice. Even among students that start in a mixed rural practice in Australia more than half leave within five years (Heath, 2004). Students from urban backgrounds, who may never have handled horses before, are at an even greater disadvantage compared to the more traditional student with a rural background, who was probably already basically competent around horses (Cawdell-Smith et al., 2007; Stafford and Erceg, 2007; Waran et al., 2014).

By developing equine-handling skills veterinary students increase their value to future employers, have a smoother transition into practice, increase in confidence and may have a reduced risk of injury (Cawdell-Smith et al., 2007; Chapman et al., 2007; Hanlon et al., 2007; MacLeay, 2007). Effective handling improves the safety of not just the students but also bystanders, and minimises stress and pain for the animal (Hanlon et al., 2007; Stafford et al., 2007). Various Universities are starting to provide animal behaviour including learning and motivation, Colorado State University College begins its animal-handling courses with an

introduction to learning theory (MacLeay, 2007). Sydney University teaches handling of equids, ensuring that students understand that any pressure applied should be released as soon as the animal begins to comply (i.e. using negative reinforcement accurately). Students learn that minimal but effective force should be used because this reduces the stress and negative associations made by the animal. It is emphasised that excessive force may lead to increased fear and escape attempts, which, if successful, will be repeated more readily in the future. The University of Edinburgh now has dedicated lectures covering the practical application of learning theory to challenging equids, delivered to students just before entering their final year rotations. This small intervention has resulted in increased confidence in students within the hospital and allowed them to practise behaviour modification of equids aversive to oral medication or injections in a safe and controlled environment (Waran et al., 2014). Students interested in further training can take an optional three-week elective rotation in behaviour and welfare that delivers further material on learning theory and, most important, practical classes where students can practise training horses in the basic operant responses (acceleration and deceleration cues), as well as backing up and training them to stand and remain still). Target training using positive reinforcement is also taught (Waran et al., 2014).

Allowing students to handle more fractious animals poses several challenges (e.g. student safety) and welfare and ethical dilemmas (for example the question of whether students should be allowed to practise on animals already demonstrating a degree of stress). Perhaps a way forward is to train the undergraduate student behaviour modification techniques using safe and docile animals. For example, a horse may be mildly averse to receiving oral medication but after the student is taught the correct application of both positive and negative reinforcement they can train the horse to accept medication calmly. This allows the student to develop skills not routinely taught, but that may prove useful if a more fractious horse is encountered later in practice (Waran et al., 2014) (Fig 1 & 2). In the

future development of equine specific manikins or virtual simulation may help to provide a safe and effective learning environment, as is already utilised in small animal teaching (Valliyate et al., 2012) The veterinary curriculum is already overfilled with lectures and practical classes – due to a world of ever-increasing knowledge – and dedicating time to training veterinary students in learning theory and its application to handling equids will continue to be challenging, unless its importance is emphasised and prioritised by those responsible for the veterinary curricula. However teaching on the subject of safe handling of difficult equines becomes increasingly difficult to justify as the majority of veterinary graduates go into small-animal practice. Also the combination of increasingly tight budgets, ever-expanding class sizes and graduate preferences for small-animal practice makes keeping a herd of horses available solely for student training increasingly difficult to justify. A computer model was found to be a superior teaching method when compared to traditional instruction of how to pass a nasogastric tube in a horse, with students that undertook the computer based learning achieving the practical faster than those that received traditional instruction (Abutarbush et al., 2006). Hopefully future development of computer-assisted learning packages specific to equine learning theory will improve students' ability to handle more fractious animals.

4. The importance of understanding learning theory to optimise effective handling and restraint

Horses presented to veterinarians can be fractious because of their clinical condition but they may also be largely unhandled or have acquired dangerous responses from previous veterinary interventions and/or handling techniques. In addition, there may be considerable

variation in the safety of facilities, competence of handlers and the extent to which the horse is already primed with adrenalin secondary to trauma, pain or behavioural extremis. In the face of necessity, generations of horsemen have developed roping techniques and other forms of physical restraint that allowed them to carry out aversive husbandry practices on otherwise fractious animals (Fraser, 1992; Rose and Hodgson, 1993; Waring, 1983). Applying constricting pressure to the upper lip (use of the twitch), grasping the ear, and pinching a fold of skin are all commonly used restraint methods for a range of potentially aversive procedures (McGreevy, 2004). Most of such techniques are thought to create a painful focus that is, at least initially, of more salience than the painful procedure (veterinary or other) being carried out on another part of the horse's body (McGreevy, 2004). However, the release of beta-endorphins during use of the twitch suggests an analgesic effect of the twitch which may reduce pain during otherwise painful procedures (Lagerweij et al., 1984) and may contribute to reduced fear of potentially frightening procedures such as clipping (Ali et al, 2015). In light of recent developments in equitation science, in particular a greater understanding of the importance of applying learning theory to handling, training and control of horses, (Fig 3 & 4) the need for, and advisability of continued use of such practices is questionable on several levels:

i. Facilitating habituation to a potentially fear-inducing stimulus results in a reduction of fear, thus facilitating calmness and improved tolerance of a previously aversive stimulus (Christensen et al., 2006; Houpt and Mills, 2006). This may reduce the need for many traditional forms of restraint (e.g. a gradual approach to potentially aversive procedures such as passing a naso-gastric tube or placing an oral gag prior to oral examination may pay dividends in terms of reduced resistance). Reduced fear means that during future applications of the same stimulus, handling and management

challenges will have diminished, increasing the ease with which these horses can be managed both for clinical and non-clinical interventions.

ii. Applying aversive stimuli to horses that are physically restrained can compromise their welfare. In addition, during such procedures negative associations with personnel or other aspects of the experience (such as location, odour, sounds) may result in fear that can trigger flight behaviour and impede learning under similar circumstances in future (location, personnel, scent for example) (LeDoux, 1994).

iii. Physical restraint allows the application of noxious stimuli, at a level and for a duration that in current veterinary medicine are deemed unacceptable (Ladd, 2001) and counterproductive. Allowing an animal to experience pain during a procedure increases the risk of induction of hyperalgesia, which may persist long after the procedure has been carried out (Sandkühler, 2009). Analgesic administration to minimize nociceptor activity during and following surgery is standard practice (Johnson et al., 1993). Opting to use restraint measures rather than appropriate chemical restraint is negligent from both an ethics and welfare perspective. Short periods of restraint may be justified to allow the appropriate medication be administered to ease accurate delivery of medication and to lessen the likelihood of injury to personnel. However, unless these are countered with restraint methods that lead to positive outcomes (e.g. food rewards), they are likely to create unwelcome associations in the medium-to-long-term.iv. Plasma beta-endorphin concentrations have been shown to peak in horses in the early morning (Hamra et al., 1993). If elective noxious or aversive procedures are, scheduled for that time they might induce lower levels of pain and consequent fear (Saslow, 2002).v. While the initial result for the horse of applying a twitch is likely to be a high level of pain, production of beta-

endorphins has been shown to occur quite rapidly, reducing pain levels (Lagerweij et al., 1984). The use of the twitch as a method of restraint can be justified only if it enables the administration of a psychotropic drug (McGreevy, 2004).In light of the above, the use of effective and evidence-based handling and restraint methods by veterinarians is essential for several reasons:• To reduce the likelihood of the horse struggling and resisting examination and treatment.• To demonstrate the most effective way to the owner of restraining and managing the horse during subsequent necessary interventions, such as administering medications, changing dressings, etc.

• To develop a relationship of trust with the owner. Watching the veterinarian use effective, rapid-acting and humane handling techniques that result in a calm horse will increase the owner's trust in and respect for the veterinarian.

• Using internationally recognised best practice protects the individual veterinarian from possible litigation, whereas the use of techniques not based on scientific principles may be interpreted in a courtroom setting as professional negligence.

5. Methods for improving Veterinary Management of Horses for examination and treatment

Building a relationship with a client by acknowledging and relating to his/her animal is a critical element in veterinary consultation models (Radford et al., 2006). In addition to reducing the ease of carrying out a detailed clinical examination, inappropriate handling can affect diagnostic parameters (McGreevy et al., 2005) and even play a critical role in a compromised patient's ability to cope (Broom and Johnson, 1993). However, reactivity in

horses may be lowered through correct handling procedures and by learning appropriate novel responses (Nicol, 2002). For example, through operant conditioning a horse may be taught to remain immobile on command, and also to lower the head (McLean and McLean, 2005). Both responses are incompatible with fear and flight responses and increase the ease and safety with which a medical examination can be carried out. An education in ethology and learning theory also equips veterinarians to recognise ways in which horses successfully modify the behaviour of naïve handlers and facilitate the education of owners in the application of learning theory and the use of training principles. Ultimately this will improve not only equine behaviour during veterinary examination and treatment but also during general day-to-day handling and husbandry (McGreevy, 2004).

When handling horses during potentially pain- or fear-inducing situations, it pays to bear in mind that horses rarely forget aversive procedures (LeDoux, 1994). Spontaneous recurrence of fear responses at a later time may compromise safety of both horse and handler, by resulting in unpredictable and potentially dangerous fear / evasive responses during future veterinary interventions In addition, through advances in the study of moods in animals, it is thought that a negative mood can be brought on by a series of aversive experiences, resulting in increased escape or avoidance tendencies (McBride and Mills, 2012).

Classical conditioning allows an animal to form associations between neutral or unconditioned stimuli (such as a particular scent) and aversive stimuli (such as the experience of fear) and these can perpetuate fear responses in that horse when subsequently exposed, for example, to the scent. However, the use of scent, in the form of calming pheromones, may also facilitate a reduction in anxiety levels in horses during fear-inducing situations (Gaultier and Pageat, 2002) and the commercial availability of a synthetic equine appeasing pheromone, shown to reduce cardiac and behavioural indicators of fear, may benefit

clinicians who routinely handle frightened horses (Cozzi et al, 2013; Falewee et al, 2006; Van Sommeren and Van Dierendonck, 2010). By the same token, it is quite possible that frightened or emotional handlers may emit odours that increase arousal levels of horses being handled (Saslow, 2002), making safe and effective handling or training more difficult.

Primary reinforcers, such as food, may be of value in both positive reinforcement and counterconditioning. In addition, vigorous scratching in the region of the withers, easily applied by a handler, reduces heart rate (Feh and de Mazières, 1993) and may also be of use in counterconditioning, such that a positive association with a previously aversive stimulus may be facilitated (Fig 5). Positive reinforcement can also be successful in shaping new, desired responses, such as approaching or entering an area that previously elicited stalling or escape attempts. After training the horse to approach a novel target through positive reinforcement, the target can then be placed progressively closer to, and eventually at the desired location. This has been used in overcoming aversion to trailer loading (Ferguson and Rosales-Ruiz, 2001), and could be used in veterinary hospitals or clinics. Combined or individual use of positive reinforcement and targeting could help overcome fear of / aversion to entering examination or procedure areas such as stocks and prep areas. Positive reinforcement may have limited ability to overcome high levels of fear, but that said, the use of positive reinforcement and counterconditioning responses to less aversive fear-inducing stimuli may reduce the levels of restraint and/or medication required (Fig 6).

Training desired responses or eliminating undesired ones may be more successful if the training method selected is the most suitable one for the temperament of the horse in question (Starling et al., 2013). Neurobiological and behavioural studies have identified consistent differences in individuals in relation to:

i. Sensitivity to aversion (these horses are more likely to be described as "flighty", "highly reactive to novel objects" or "neurotic" (Gosling and John, 1999).

ii. Sensitivity to reward (these horses are likely to be described as "extrovert", and are more likely to show higher levels of exploratory behaviour) (Morris et al., 2002).

Positive reinforcement may be very effective in horses that are highly motivated to acquire a reward, whereas a low level of pressure (through the use of negative reinforcement) may be sufficient to achieve performance and training of the desired responses with horses that are highly sensitive to aversion (Lansade and Simon, 2010). Positive reinforcement has the added advantage of inducing positive emotional responses to the training situation (Sankey et al., 2010), which subsequently reduce the likelihood of escape or avoidance efforts by the horse in that situation (McBride and Mills, 2012).

While further research is required, it has been suggested that head-lowering results in increased calmness and that this may be used to lower arousal levels in anxious horses (McLean and McLean, 2005). Mean arterial blood pressure has been shown to significantly decrease in horses when the head is lowered (Parry et al., 1980). Given that most veterinary examinations and treatments require immobility, lowered arousal levels are desirable. Excessive arousal may lead to reduced performance (Bridgeman, 2009; McBride and Mills, 2012) or reduced ability to learn new responses (Broadhurst, 1959) and will hamper the efforts of the veterinarian or handler to control the horse and achieve the desired levels of immobility. Therefore, teaching the horse to lower the head through the use of negative reinforcment may be of value, particularly in hospitalised horses subjected to repeat clinical examination or procedures. Hospitalisation will facilitate such training during short but repeated training sessions which will help increase control and immobility and reduce arousal levels while being examined / treated.The application of learning theory by veterinarians in their day-to day handling of horses that are frequently frightened, in pain and highly aroused will reduce injury, improve welfare, reduce the frequency of litigation arising from inappropriate or ineffective handling techniques and strengthen the vet–client bond.

6. Suboptimal training methods prevent horses from reaching their perceived performance potential

Many equine athletes fail to reach their perceived potential in training and competition due to the use of training methods used by coaches that do not align with the horse's learning abilities (McLean, 2005a). While learning theory is being taught to students of psychology, its presence in the curricula of equestrian coaches remains infrequent (Warren-Smith and McGreevy, 2008; Wentworth-Stanley, 2008). Insufficient understanding of the mechanisms

that underpin the most common training construct in horses, negative reinforcement, among coaches and consequently their pupils is thought to contribute to suboptimal technique. Such errors will result in a failure to reward the desired behaviour and inadvertent rewarding of undesired responses (Mills and Nankervis, 1999), both of which will lead to poor acquisition of desired responses (McGreevy and McLean, 2010).

In the absence of detectable clinical problems, suboptimal performance of the equine athlete can prove highly challenging for veterinarians. Among other factors, it can reflect the deleterious effects of certain training methods (McGreevy and McLean, 2010; McLean, 2005a), fear, pain, or fear of pain (Casey, 2007) and stress (Anshel and Anderson, 2002).

Almost all equine training methods rely on negative reinforcement (i.e. the immediate removal of pressure when the desired response has been offered (McLean, 2005b). Pressure is usually applied via equipment such as the bit, bridle and spurs and also by direct application of leg pressure. While data on acceptable levels of bit-induced pressure are still lacking, it is highly likely that bits are capable of applying highly aversive levels of pressure to sensitive tissues in the oral cavity (Cook and Strasser, 2003). Detection of pain in horses is notoriously difficult (Dalla Costa et al., 2014), so the challenge for anyone handling horses is to identify when pressure becomes pain (McGreevy, 2011).

Horses behavioural responses to pain and fear are similar (Casey, 2007), typically showing evasive or flight responses in order to reduce exposure to the painful stimulus. Pain during an interaction with a rider or trainer may result in anticipation of pain (and resultant fear) during future interactions with that handler or in similar circumstances (McBride and Mills, 2012). In addition, fearful animals are less likely to trial new responses (Broadhurst, 1959) and thus become more difficult to train. Fear is also thought to persist indefinitely (LeDoux, 1994). So while trainers may condition novel behaviours to replace previously

performed undesirable fear responses, spontaneous regression is still possible. Therefore, avoidance of both pain and fear during training are essential for both optimal welfare and performance.

In addition to the possible impact of pain or fear, advances in the study of mood in animals may help inform trainers' choices of training methods (Starling et al., 2013). Repeated aversive or unpleasant experiences are thought to induce a negative mood that may increase the likelihood of an animal performing escape and avoidance responses (McBride and Mills, 2012). Where possible, the use of positive reinforcement instead of, or alongside, negative reinforcement will help create positive emotional responses to training situations (Sankey et al., 2010). Furthermore, the level of arousal is recognised to influence the outcome of training in animals, with different levels of arousal best suited for the training of tasks of varying degrees of complexity (Broadhurst, 1959). Further exploration of the interaction of arousal and mood and how these influence the effectiveness of different training methods, in particular those based on operant conditioning, have been described (Starling et al., 2013) and it is likely that progress in this area will substantially optimise training.

Stress has been shown to compromise learning and performance in several ways, including reducing the working memory (Valenchon et al., 2013), and causing atrophy of the hippocampus (Sapolsky, 2000; Watanabe et al., 1992), which may also result in a reduction in memory formation. Other recognised physical consequences of stress in horses include gastric ulceration (McClure et al., 2005). The causes of equine gastric ulceration syndrome (EGUS) are multifactorial and may reflect feeding regimes, inter-feed intervals, timing of exercise relative to feed availability but also a legacy of stress (Luthersson et al., 2009). High levels of gastric ulceration have been found in horses used in various equestrian disciplines (Luthersson et al., 2009). It has been argued that where training methods contribute to high

stress levels, and result in gastric ulcers, equine performance may be compromised (Franklin et al., 2008).

Learned helplessness is a psychological condition that can emerge after exposure to unpredictable aversive situations that the animal/individual has no control over and from which it cannot escape (Maier and Seligman, 1976). Eventually an animal with learned helplessness will no longer even try to escape the aversive situation even if the opportunity arises (Hall et al, 2008) Training methods that rely on the sustained use of high levels of pressure, from which the horse cannot escape by offering the desired response, can affect training and performance. Learned helplessness in a riding horse may reduce responsiveness to a rider's cues (Odberg and Bouissou, 1999). Riders or trainers unaware of this process may apply stronger pressure (in the form of spurs, whips, and more severe bits) that may result in the horse experiencing pain or fear. The outcomes of learned helplessness are said to include deficits in motivation, cognition and emotion (Maier and Seligman, 1976). In species other than horses, these have been shown to reduce performance, learning ability and, ultimately, cause emotional depression. Learned helplessness is thought to occur in ridden horses, with some equestrian training techniques imposing the conditions likely to induce this state (Hall et al., 2008). Definitive diagnosis of learned helplessness in a horse is difficult since the condition is not accompanied by measurable changes in clinical parameters, and the horse may appear to be compliant in training and performance, but it should be on the veterinarian's list of differential diagnoses in investigating suboptimal performance in horses.

Conflict behaviours are undesirable, sporadic behaviours thought to be performed as a result of a loss of predictability and controllability in an animal's world (Wiepkema, 1987) (See Christensen and McLean in this issue). Lack of clarity and consistency in an animal's world results in the performance of conflict behaviours in a range of species. Conflict

behaviours displayed by horses include hyper-reactive responses such as bucking or bolting (McLean and McGreevy, 2010). In the ridden horse, inconsistencies in handling and training methods, or the application of opposing pressures (such as simultaneous leg and bit pressure where horses are ridden with so-called strong contact) may contribute to the performance of conflict behaviours, which not only detract from performance but also jeopardise the safety of both horse and rider (McGreevy and McLean, 2010).

While the above factors may be of primary importance to trainers and riders, awareness of the impact of stress, fear, pain, inconsistency and lack of predictability on the horse may help to improve a veterinarian's ability to first, handle interact with directly and second, diagnose the causes of under-performance of equine athletes at all levels. Following the diagnosis and elimination of clinical problems that contribute to reduced performance, a working knowledge of the environmental factors and training methods that affect performance will allow the veterinarian to modify environmental, management and training factors and facilitate a return to optimal performance.

7. Equine welfare problems due to widespread lack of understanding of the principles of learning

In all horse-handling situations, including training and restraint, the use of pressure (through the application of negative reinforcement) carries the inherent possibility of pain and, in some cases, tissue damage (McGreevy et al., 2012). Whether or not the welfare of a horse is threatened as a result of a human intervention depends on how the horse perceives the interaction (Mills, 1998a). Development of a validated horse grimace scale for scoring pain is a welcome advance in the area of pain detection in horses (Dalla Costa et al., 2014) although it is of use as a research tool rather than of practical use in the field. Behavioural

indicators may not faithfully reflect physiological responses, such as heart rate, to stressful or fear-inducing situations (Christensen et al., 2006). This may be inherent to being herbivorous in that overt manifestations of distress may attract the attention of predators. Regardless of the origins of the tendency not to show behavioural indicators of pain, it generally increases the challenge of detecting distress and safeguarding horse welfare.

Where uncontrolled flight responses may threaten safety of both horse and rider, the use of high levels of pressure to control the horse may be justified (Hawson et al., 2010). However, where training methods routinely rely on coercion through force rather than the use of subtle pressure and methods that align with the horse's natural learning abilities and limitations, reduced progress and a higher frequency of problem behaviours is likely (McLean, 2005a). The routine use of particular methods of training and restraint, accepted both by the equestrian community and regulatory bodies, is coming under scrutiny for possible deleterious effects. For example, excessive tightening of nosebands, facilitated by a "crank", may cause reduced blood perfusion to skin distal to the noseband and may increase stress levels (McGreevy et al., 2012). Whip use in horseracing may cause pain and tissue damage and has been greatly restricted in Norway as a result of public concerns (Jones et al., 2015).The use of draw reins, a system of reins used by riders to draw the horse's head towards the chest have been banned at competition venues in Switzerland as of 1 January 2016 (Leste-Lasserre, 2015).

Some behaviour problems, historically thought to be the consequence of clinical problems, may be attributable to poor riding and training (Waran, 2005). Most behaviour problems can be treated successfully through assessment of the problem based on an understanding of learning principles and can subsequently be modified by application of the

principles of learning theory (Cooper, 1998; McGreevy and McLean, 2010; McLean and McLean, 2008).

The low levels of knowledge of learning theory found among coaches in Australia and Canada (Warren-Smith and McGreevy, 2008; Wentworth-Stanley, 2008) and the widespread absence of learning theory in the veterinary curriculum imply that methods of training and restraint that do not align with known learning abilities of the horse are prevalent. If trainers, riders and handlers have a poor understanding of learning theory, higher levels of restraint, or in many cases punishment, are likely to be the method of choice in situations that cause fear or flight responses in the horse. The use of punishment can quickly result in reduced welfare and possible abuse of the horse (Mills, 1998a). The appropriate application of learning theory contributes to reduced wastage in the horse industry (Minero and Canali, 2009) and increased rider and handler safety (Hawson et al., 2010).

It is unlikely that causes of stress responses in the ridden horse can be completely eliminated from equine training procedures, but the concept of ethical equitation demands that recognised stressors are mitigated (Jones and McGreevy, 2010). Standard steps in training, such as mounting the horse for the first time, have been shown to result in an increase in salivary cortisol production (Schmidt et al., 2010). Other common techniques used in training have been shown to impact a horse's life not only during training but also between training sessions (McGreevy et al., 2010). Techniques such as hyperflexion may trigger confusion, loss of pre-trained responses to bit pressure, and behaviours indicative of conflict (McGreevy et al., 2010). However, with the progress of research in learning theory, the use of techniques known to reduce physiological stress responses can help safeguard equine welfare by guiding the choice of training and control techniques. For example, desensitisation to a fear-inducing stimulus has been shown to result in fewer flight responses

and a shorter time to achieve the desired loss of flight response to the stimulus than either counterconditioning or habituation (Christensen et al., 2006).

The role of the veterinarian as a clinician, working towards restoring full health and optimal performance should not overshadow the responsibility of the veterinarian to safeguard the horse's welfare. While the impact of feeding regime, housing and routine management on welfare and behaviour have been described elsewhere (Cooper et al., 2000; Franklin et al., 2008; Luescher et al., 1998), it is important that veterinarians do not automatically assume that training methods, even those used by elite riders, are optimal (McGreevy et al., 2011). The use of suboptimal training methods can compromise health as well as performance and welfare. Treatment of presenting clinical problems without addressing the causal training methodologies is likely to result in recurrence of presenting problems and further deterioration of welfare.

8. Wastage in the equine industry

Wastage in the horse industry is an issue that should concern veterinarians for a number of reasons including welfare concerns and financial implications for owners and the industry as a whole. Lack of widespread understanding of learning principles contribute to the development of behaviour patterns which contribute to horses being retired or transferred from the equestrian sport for which they were bred and may contribute directly to wastage figures. The financial and welfare implications of wastage within the horse industry have prompted a range of studies into the rate at which horses are removed from the discipline for which they were bred. Many of these studies focus on the Thoroughbred racing industry, with fewer data being available on levels of wastage among non-Thoroughbreds. For the practising veterinarian, such studies help to throw light on the clinical conditions most

responsible for loss of training days, or performance, and may help inform the development of preventive measures to be applied to management and training regimes. Lameness is a predominant cause of loss of performance days, responsible for 57% training failure among the racing Thoroughbred population in a study by Lindner and Dingerkus (1993), with respiratory problems cited as another major problem. The main reason, however, that Thoroughbreds do not enter the racing population is likely to be related to behaviour (i.e. lack of locomotory potential). There is evidence that Thoroughbreds that are not calm before racing underperform (Hutson and Haskell, 1997), so the failure to handle racehorses correctly as juveniles and novices can compromise their potential as racehorses for life. A recent development within the horse industry, whereby racehorses are re-trained for general use as a non-racing riding horse goes some way toward addressing the issue of what happens the racehorse when its racing career has ended. Interest in this development has been catered for by the introduction of 'Racehorse to Riding horse' classes at many horse shows in Ireland and the UK in recent years.

Most published studies have examined details of clinical problems, but have provided less detail on causes not categorised as clinical problems. The explanation "horses showing little or no ability to race" was cited by Jeffcott et al. (1982) as the most common reason for Thoroughbred racehorses not competing or competing less than the average number of times. "Miscellaneous other conditions", and "unknown causes" accounted for 10% of wastage in Thoroughbred racehorses in Guanteng, South Africa (Olivier et al., 1997), while 28% of 171 UK owners of event horses declined to re-register their horses for a second year as they felt the horse had under-achieved (O'Brien et al., 2005). In the same study, 8.2% cited "other reasons". Withdrawal of 4 horses (out of 16) and 2 ponies (out of 6) selected for participation in the European Eventing Championships (2010, 2011) was attributed tothe "Animal not meeting the competition criteria" (Munsters et al., 2013). In France, 66% of 3100 horses sent

for slaughter were aged between two and seven years. Clinical reasons for slaughter were not available (Odberg and Bouissou, 1999). In a separate study, clinical reasons were cited as the cause for slaughter of up to 48% of 2975 horses (average age 8.5 years), in a Munich abattoir with no clinical reasons listed for the remainder (Odberg and Bouissou, 1999). This led to the authors positing that behaviour problems may be the cause of slaughter in a significant number of young and clinically healthy horses.

In a study investigating the incidence of misbehaviour in Pony Club horses and ponies, owners recorded misbehaviour during 3% of days when the horses were ridden; of these, 52% of incidents were classified as "dangerous" (Buckley et al., 2004)., The frequency of injuries caused by horses or horse riding has been recorded in a large number of studies and summarised by Hawson et al. (2010). Breeding for traits deemed desirable in competition, such as a particular temperament or gait characteristics, may contribute to inadvertent selection for other traits that increase the requirement for better equestrian skills and training abilities (McLean and McGreevy, 2010).

The veterinarian is ideally placed to advise horse owners, riders and trainers on ethical and evidence based training and handling methods that should be utilized to address deficiencies in training and behaviour. Clearly, this is a novel role for many veterinarians but it is expected to grow (Derksen and Clayton, 2007). Failure to give appropriate advice may contribute both to loss of the horse or pony from the practice and also the owner as a client, with subsequent commercial implications. However, of greater concern are the welfare implications of the consequences of reduced equine performance. The prevalence of the use of anthropomorphic descriptions of equine misbehavior (Hawson et al., 2011; Oddie et al., 2014) suggests that when a horse is deemed to be lazy, bold or strong, stronger methods of control are used. . In the situation where equine performance fails to meet expectations, riders

and trainers are likely to take remedial action. When such measures succeed, horses and ponies are likely to progress or at least remain performing within their discipline and will not contribute to the wastage statistics. In contrast, where attempts to address the apparent deficit in the horse's performance are unsuccessful, it is likely that before being sent to slaughter or retirement, greater levels of force, restraint or punishment may have been applied. There are no data documenting the methods used in advance of decisions being made to retire, sell or slaughter/euthanize horses due to inadequate performance. However, it is possible that the welfare of the horse in this situation may deteriorate while owner, trainer or rider attempt to address the existing problem.

For every horse failing to reach its perceived potential and contributing to wastage statistics, there are likely to be attendant threats to welfare. Without accurate data, the true contribution of behaviour problems to wastage statistics will remain unknown. Further research is warranted to identify the contribution of behavioural issues to slaughter and overall wastage figures.

9. Conclusion

The rapid development of the field of equitation science over the past decade promises to have a positive impact on equine welfare worldwide. The prospect of veterinarians applying and disseminating the principles of learning is exciting because it has the potential to improve welfare, reduce wastage and optimise performance. For this to occur, incorporation of learning theory and equitation science into veterinary curricula is essential. With thorough working knowledge of the principles of equitation science, equine veterinarians can increase their own safety and clinical efficacy while improving their relationships with clients. Veterinarians with these competencies can identify and resolve

causes of sub-optimal performance and educate handlers and owners in optimal handling and training methods.

Incorporation of equitation science and learning theory into the veterinary curricula is essential for the veterinary profession to keep abreast of the rapid advances in the field of equitation science and become scholars in the field. Horse owners and riders have increased expectations of the veterinary profession to apply evidence-based handling techniques. Although, to some extent, these expectations are likely to drive the veterinary demand for professional development in equitation science, proactive engagement by the veterinary profession remains essential. In addition to the benefits outlined above, veterinarians educated in equitation science can be expected to help assure the welfare of horses by assisting in the development of competition regulations that prohibit the use of training methods or equipment known to compromise welfare. For equitation science to blossom fully in veterinary contexts, further research is needed in many areas, including the accurate detection of pain, the impact of traditional training methods and equipment on welfare and performance and the degree of wastage in the horse industry due to undesirable behaviour.

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Research highlights

Not applicable

Figs 1 & 2: Using negative reinforcement, the handler removes the syringe each time the horse relaxes, thereby rewarding the behaviour. Progressing gradually from the cheek towards the mouth allows administration of oral medication without creating a fear response in a horse that was previously averse to receiving oral medication.

Figs 3 & 4: Horses can be trained to calmly accept examination using positive reinforcement rather than restraint

Fig 5: Scratching a horse around the wither region enables relaxation in this mare who had been anxious about her foal receiving treatment

Fig 6: Distraction with a 'Licket™'